bear the yellow character and half of them the white. In the last generation a similar test was applied to the male germ cells with the same result.

(4) The experiments were carried out under fully "biometric" conditions, the more accurate "Mendelian" method of careful pollination between individual plants being deliberately avoided. Thus, in generation iv. pollination was effected by the aid of the wind from some 1800 recessive parents indiscriminately.

A somewhat fuller description of the early part of this experiment has already appeared in vol. ii., part ii., of the *Annals* of the Royal Botanic Gardens, Peradeniya, and a complete account will be published in a future number of the same journal. R. H. LOCK.

Peradeniya, Ceylon, September 21.

Rock Pressure at Great Depths.

IN his address to the engineering section of the British Association, Mr. Parsons speaks of sinking a shaft into the earth for a distance of 12 miles.

I think, however, he overlooks a factor which sets a limit to the depth to which a mine shaft can be sunk. If we assume that the average specific gravity of the earth's crust is 3, the superlaying rocks would exert at a distance of 12 miles a pressure of about 440 tons per square inch.

There can be little doubt that when subjected to such a pressure the rock material would give way and flow together like a viscous fluid, and so the walls of the shaft would spontaneously close up, probably before the depth of 12 miles was reached. The breaking stress of steel is only 44 tons per square inch, and so, even were the walls encased by a steel tube, this would not avail to prevent the flowing together of the walls. GEOFFREY MARTIN.

Kiel, Preusser-str. 19I, September 17.

I HAVE to thank you for directing my attention to Mr. Martin's letter in which he gives his views as to the probable behaviour of rock around a very deep shaft boring, and his opinion that the inward viscous flow of the rock would place a limit to the possible depth.

I have to thank Mr. Martin for directing attention to the question of this possible limitation, which was considered when writing my address and dismissed as unlikely to occur up to depths of 12 miles, basing my conclusion on general engineering knowledge of the flow of metals, of the relative impressions made on hard brass and on hard rock when struck by hard steel tools, and on the general behaviour of metal when forged.

I must first beg leave to point out some errors in Mr. Martin's figures; he has misplaced the decimal point in calculating the hydraulic pressure of the superlaying rocks at 12 miles depth, which should be 40 tons and not 440 tons per square inch.

Again, of the crushing stress required to make hardened steel flow I have no data by me, but am aware that it lies between 120 tons and 300 tons per square inch, and in the case of hardened knife edges for weigh bridges, if my memory is correct, the pressure per square inch on the area of contact reaches a still higher figure.

Again, the pressure required to make the tough brass ("cartridge metal") flow is about 80 tons per square inch.

I think that the evidence at present available leads to the conclusion that after a small amount of shrinkage of the shaft sides inwards has taken place a state of equilibrium would be established enabling the surrounding rock in its state of great compression to withstand the so-called hydraulic pressure due to a depth from the surface of at least 12 miles.

Since my address I have had the opportunity of discussing the matter with Prof. G. H. Darwin, who has kindly brought to my notice the article by Tresca, "Memoirs des Savants étrangers sur l'écoulement des Corps solides," about the year 1866, and also his own paper in the *Philosophical Transactions* of the Royal Society, part i., 1882, in which the great shearing stresses that are thrown on the earth's structure by the weight of mountain ranges on elevated continents and great depths of the sea are exhaustively treated. I would only point out that such stresses have been endured for long epochs, and that in view of the established fact that rocks are viscous, it is clear that much greater stresses could be sustained for the comparatively short time necessary to complete a deep shaft boring.

It would, however, be interesting to subject a cylinder of granite or quartz rock, carefully fitted into a steel mould and having a small hole bored through its centre, to a pressure of, say, 100 tons per square inch, and see what shrinkage in the hole would result, or a hole might be bored into the specimen through an aperture in the mould while subjected to this pressure. This pressure would correspond to a depth of about 38 miles.

CHARLES A. PARSONS.

Holeyn Hall, Wylam-on-Tyne, October 7.

The Berlin "Thinking" Horse.

IN your issue of September 22 there is a paragraph among the notes (p. 510) with reference to "Clever Hans," a "thinking horse" at present displaying his powers in Berlin. With reference to it I wish to say that twelve or thirteen years ago there was on exhibition in the Royal Aquarium, London, a horse of, if I mistake not, exactly the same stamp. I happened to be then attending lectures at the Royal College of Science, and I went to see the animal. I had, moreover, a long conversation with his trainer, who eventually let me see exactly how it was all accomplished.

With all respect to the members of the "representative committee" at Berlin, I am driven to hold that the performances recorded, counting the number of the audience, picking out the tallest man present, telling the hour, &c., which seemed so deeply to impress them, partake of the nature of a stage trick. They demonstrate what training and perseverance can do with animals rather than the possession on their part of any advanced mental powers.

The Aquarium horse was named, if I remember aright, Mahomet. He could work sums in addition and subtraction, or, for that matter, in multiplication, could count the number present in the little side-show, could make a good guess at the age of an individual, and so on. He had been taught to begin pawing the ground when his trainer looked straight at him, and to cease when the trainer turned his gaze to the floor. It is easy to see the countless changes that can be rung on this accomplishment. Telling the time on a watch or the day of the month are readily recognised to be among them. Similarly, he had been drilled into bowing his head at one tone of his trainer's voice, and shaking it on hearing another. Again one can readily imagine how this bit of instruction will lend itself to a very varied and wonderful display of cleverness.

Mahomet's owner was an American and followed the business of training horses, especially circus ones. This horse, he discovered, was very easily taught—a genius among his kind—and on him he then lavished years of most careful labour, often, he assured me, sleeping of nights in the manger at his head. The results were as shown. They were in themselves sufficiently marvellous, and represent, I fancy, the very utmost that a horse can be trained to do. "Clever Hans" would seem to be blessed with a trainer as painstaking and persevering as my American friend.

After a *séance* which I had all to myself, Mahomet's owner delayed with me to see the performance of a clever dog on the central stage. The dog, a fair specimen of a rough collie, answered questions, spelt his own name, words sent up by the audience, &c. The letters of the alphabet were placed in order in a wire frame towards the back of the stage. The collie went along the letters, picked out the one he needed, and brought and laid it before the footlights. He then went for the next. Wonderful I thought the performance until my friend the horse-trainer showed me how it was done. The collie always began at A. He then trotted along up the alphabet until he reached the one he needed. His master carried his gloves in his hand. A little twitch of the gloves as the dog passed the particular letter wanted was the cue. The well trained animal took in the slightest stir of the gloves with the corner of his eye. This dog even played a game of cards—and won. A hundred and one variations might be made on the same trick.

I have read since in an American newspaper of a Tennessee

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pig that acquitted itself creditably in practically the same *rôle*. Doubtless, if the report were true, the porker had swallowed an equal amount of learning.

The collie was without doubt a good, clever one. As member of the Irish Collie Club I have for years past taken a fancier's interest in this particular breed, and I have observed every degree of intelligence, from the brute that could scarcely be taught to bark at a cow—oftenest with a pedigree as long as your arm—to the affectionate animal that could guess almost your thoughts and your passing temper, and was always in perfect sympathy with your moods. The best of these, however, falls far short of a good Irish water spaniel. From my experience, I may be allowed to say in passing that no breed is so teachable—has such brain-power, if you like—as the latter, once he has reached the age of nine or ten months. As puppies I found them rather stupid.

Performances similar to that of the Royal Aquarium collie are not very rare. There are, indeed, some other ingenious stage devices by which a dog can be taught to spell—every word in the dictionary if you are so foolish as to let it be known—and to converse, so to speak, in Russian as readily as in English, but the devices are rather worked out.

Usually such show dogs modestly protest before the audience (through their trainers) their inability to do more with certainty than spell correctly words of three letters, and when pushed they get perplexed and make mistakes. This, for them, is sound policy. It is only when they grow too bold and set up as " thinkers " that they are found out. My American trainer, with Yankee shrewdness, used to claim for his dark bay charge that when he had totted up a row of figures he should be reminded of the number to be carried on to the next column. This was fair enough. It, too, served to baffle the over-canny. That the arithmetician's education could never overstep that was just the puzzle they fastened on and worried over. I wonder what the German professors, good, easy men, would have said had they seen, as I did, Mahomet figure out a sum with his tail to the board!

I may be permitted to add that about the same time I interviewed the ape famous for counting, " Sally " by name, in the London Zoological Gardens, and I was in no way impressed by her intelligence. After what I have written it is not hard to suggest two or three ways by which the oracle could have been worked. I saw her count her straws for the keeper alone, and that gentleman appeared to me none too tolerant of questions or of interference.

I am prepared for believing, however, that counting is not beyond the scope of an animal's powers. It is said that Scotch shepherds count their flocks of sheep in this wise: they drive them through a gap, and the faithful collie ticks off by a bark every score as it passes through.

It is not of late alone that clever horses have come to the front. I happen to possess a MS. diary written by a co. Leitrim man in 1658 and 1659. In the first of these years the writer, James Reynolds, accompanied to London his uncle, Sir James Ware, Auditor-General of Ireland, and famous as an antiquary. Among the sights of the metropolis he records that he saw a " Nagg " which could count, answer questions, and fire off a small cannon.

There are undoubtedly degrees of intelligence within limits in all mere animals. They are particularly observable in the dog and horse—the most highly developed in this respect of all our animal friends. As every jarvey knows, each horse has a character of its own and mental powers all its own. The same is true of our canine subordinates. A neighbour of mine has a cat which climbs up the door-post and opens the latch with her paw when she wants to enter the house. This for a cat is, I think, more wonderful than are all the performances of the Berlin " thinking horse " for a steed. It is a trick, indeed, I have seen taught two or three dogs. But the cat has had no training. She owes her cleverness solely, I am assured, to her own powers of observation.

I am open to conviction, but I am greatly afraid the " German representative committee," including the " professor of the Physiological Institute of the Berlin University," that have reported, according to the daily Press, on " Clever Hans " have written themselves down as at least not ungullible. JOSEPH MEEHAN.

Creevelea, co. Leitrim.

Misuse of Words and Phrases.

IN your issue of October 13 attention was directed in the letter column to the misuse of language by English scientific writers. Since the subject of the indictment is one of importance, and since the criticism is in my opinion well founded, I am writing to support it.

There seems to be a tendency growing among writers on scientific subjects, both in pure and applied science, to modify the English language to such an extent as to give rise to no small anxiety with respect to its future state in scientific literature.

Even if language is plastic, its plasticity is limited.

Since science is based upon accuracy, the communication of scientific thought should be accurate. Yet in a large percentage of scientific publications in the English language sentences that are grammatically ambiguous occur frequently, and not seldom such as have no meaning. The sense intended may be, indeed, derived from them, either through study of the context, or through exertion of one's scientific instinct; but it is surely just to demand that the unnecessary labour of a cryptogrammic research be not inflicted on the reader. Viewed in its crudest aspect, such misuse of language is an act of discourtesy to the reader; so legitimate resentment should provoke no surprise in the author.

It is common in a certain class of publications to meet files of nouns marching through the paragraphs. Although this may at times indicate a well grounded derivation of adjectives, yet it is frequently unnecessary, either since a suitable adjective exists, or since a prepositional or adverbial phrase conveys the meaning exactly.

Various other parts of speech are frequently misused.

There is no need for fine style in scientific literature; but good style is obligatory, because it is an essential concomitant of the accurate expression of clear thought.

October 17. F. ESCOMBE.

SCIENCE IN SPORT.[1]

THE late Prof. Tait was probably the first to bring scientific principles and methods of experiment to bear upon the mystery of the flight of a golf ball. Newton, in a pregnant note on the deflection of a tennis ball in air, gave the foundation principle, which curiously enough both Euler and Poisson rejected as of no account. Robins and (later) Magnus experimented on the effect, but it was left to Tait to work out the problem in detail. His papers on the rotating spherical projectile virtually form a new chapter in the dynamics of rotation. In these papers, and elsewhere in more popular form (*e.g.* in NATURE, vol. xlii. p. 420, 1890), he lays down clearly the conditions which must be fulfilled if a man is to drive a far and straight ball. Slicing, pulling, topping, are all completely explained along the lines of Newton's remark, numerical tests are supplied, and various possible curves of flight are calculated out and drawn.

Tait showed how the ball must be started if it is to finish aright. The difficulty the ordinary golfer experiences is to give the proper start. This is *his* problem; and the mode of solution is as varied as the temperament of the player. There is, in fact, a continuous gradation of style and effort from the simple minded golfer whose one aim is to hit the ball to the nervous and pathetically anxious one who looks to every detail of grip and stance as a *sine quâ non* to perfection. There must, however, be a best way for every individual, and in discovering this the aspirant no doubt should be guided by scientific principles.

This is, perhaps, the most important practical standpoint from which to view Mr. George W. Beldam's interesting and beautiful book, " Great Golfers. Their

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[1] " Great Golfers. Their Methods at a Glance." By George W. Beldam. Pp. xxiv+481. (London: Macmillan and Co., Ltd., 1904.) Price 12*s*. 6*d*. net.

" The Art of Putting." By Walter J. Travis and Jack White. Edited and Illustrated by G. W. Beldam. Pp. 32. (London: Macmillan and Co., Ltd.). Price 1*s*. net.

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